The Uſe of a *Mathematical Inſtrument*, Called a QUADRANT.

Shewing very plainly and eaſily to know the exact Height or Diſtance of any Steeple, Tree, or Houſe, *&c.* Alſo to know the Hour of the Day by it: the Height of the *Sun*, *Moon*, or *Stars*: and to know the time of Sun-riſing and ſetting; and the length of every Day in the Year: the place of the Sun in the Ecliptick: the Azimuth, Right Aſcenſion, and Declination of the Sun. With many other neceſſary and delightful Concluſions. Performed very readily.

As alſo the uſe of a *Nocturnal*: whereby you may learn to know the Stars in Heaven, and the Hour of the Night, by them. With many other delightful operations.

The third Edition, wherein the miſtakes in the former Impreſſions are Corrected. By *W. P.*

Pſal. 92. 6. *A brutiſh man knoweth not: neither doth a Fool underſtand This.*

The Quadrants, Nocturnals, and this Book, are to be ſold by *Joſeph Moxon*, at his ſhop on *Ludgate hill* near *Fleet-bridge*, at the Sign of *Atlas*, in *London*, 1665.

To the Reader.

READER, What I have here written of the uſe of the Quadrant, *was intended for the uſe of ſome of my Friends, that underſtand not the uſe of that Inſtrument; which when* Mr. Moxon *ſaw, he requeſted the Copy of me, to accommodate ſuch of his Cuſtomers withall, as buy his* Quadrants, *and yet underſtand not the uſe of them.*

What is written concerning this Quadrant *and* Quadrat, *is written in general for all* Quadrants *and* Quadrats; *but what concerns the* Hour-lines, *is particular to this Inſtrument; and were firſt hinted at by* Stofler, *and afterwards perfected by* Mr. Gunter; *with addition of* Azimuth Lines, *&c.*

Now if you deſire to learn the projecting of theſe Hour *and* Azimuth Lines, *you muſt peruſe* Mr. Gunter, *who hath made Tables of purpoſe for the carrying on of theſe Lines from the* Equator *to the* Tropick, *for this Latitude; and given you directions how you ſhall make other Tables for all Latitudes: which here is not my task to inſert. Neither would I have you think that what I have written concerning the uſe of theſe* Hour *and* Azimuth Lines, *proceeds from my own head but from* Mr. Gunters *inſtructions; which I have digeſted into ſuch a method as I thought would be moſt plain for my friends to underſtand. Therefore to them that are unskilfull in the uſe of this Inſtrument, have I directed theſe few lines, and not to the Learned, who are better able to inſtruct me in theſe and other Mathematical Concluſions, then to receive any inſtruction from,*

Their real Well-willer.

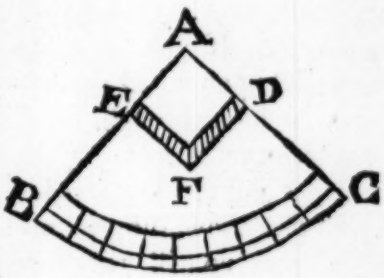
W. P.

The

The Uſe of the

QUADRANT.

A *Quadrant* is the fourth part of a Circle, and is comprehended between two Semidiameters; as in the figure A B C, where A is the Center, A B one of the Semidiameters and A C the other, and the outmoſt Verge B C is the Limb of the Quadrant: or more properly the Quadrant it ſelf; being one quarter of a Circle, and therefore is called by the Latine word *Quadrant*.



The Quadrant B C is divided into 90 equal parts, called Degrees; for, becauſe the whole Circle contains 360. Degrees, therefore the Quadrant (which is the fourth part) muſt contain 90. Degrees: each of theſe Degrees are divided into half, or quarter, or more, (as the largeneſſe of the Inſtrument will admit) being

numbred at every tenth Degree, as 10, 20, 30, 40, *&c.*

Now foraſmuch as 90 Degrees in the higheſt elevation, or loweſt depreſſion of any thing, therefore very aptly doth this Inſtrument ſerve for *Menſuration*; as for example.

If you hold the limb of the Quadrant toward you, and the uppermoſt Semidiameter of the Quadrant Parallel with the Earth or Water, then what object ſoever you behold through the Sights, is juſt ſo high above the Earth, as your Eye is. If you lift the Center untill the thread fall upon ten Degrees in your Quadrant, and then look through the Sight, as before; the whatſoever object you behold through the Sights, is juſt ten Degrees high, and the height of your Eye above the ground: Alſo if you lift the Center up till the thred fall on twenty Degrees, then what object you ſee through the Sights, is twenty Degrees high; and ſo of all the reſt.

By this you may underſtand what the Quadrant is made for, and what it repreſents: and though it may be employed for many other things, as the taking of Angels at any diſtance, yet the generall uſe is in what is aforeſaid. Now therefore I will ſpeak ſomewhat of the exact way to uſe the Quadrant, and to avoid errour in the uſe of it.

Take

Take the Quadrant in your hand, and hold it ſo that the thred to which the Plummet is fixed, may hang down cloſe by the face or flat of the Quadrant; and be ſure that the thred do not lean upon the Limb, or that it do not hang too far from it, but that it even touch it; then in this poſture bring the Quadrant to your Eye, and look through both the Sights, till you ſee the Sun, Star, or other object, which you would obſerve; then holding the Quadrant ſteddy, ſtill looking upon the Sun, Star, or other object, lay your finger upon the thred, and ſo many Degrees as you find between the thred upon the Limb, and the end of the Limb from the Semidiameter upon which the Sights are placed, ſo many Degrees is the Sun diſtant from your Zenith; and ſo many Degrees as is between the thred and the other end of the Limb, ſo many Degrees is the height of the Sun or Star you obſerve above the Horizon.

Example. Looking through the Sights to the Sun, I find the thred to fall upon 45 Degrees of the Quadrant; therefore I ſay, the Sun is juſt 45 Degrees above the Horizon; and 45 Degrees from the Zenith.

Again, looking through the Sights upon a certain Star, I find the thred to fall upon 39 Degrees and an half; therefore I ſay, that that Star is 39 Degrees and an half above the Horizon,

and 50 Degrees and an half from the Zenith.

To take the Altitude of the Sun without looking through the holes.

LEt the Sun ſhine through the firſt ſight next the Center, and bring that beam of the Sun to fall right upon the hole of the other Sight; and it will be as well or better than if you had obſerved it with your eye; and then the thred will fall upon the true Altitude of the Sun above the Horizon.

What is meant by Altitude.

THe Altitude of the Sun, Moon, or Stars, is not ſo many Miles, Poles, Rods, *&c.* as is between the eye and the Sun, Moon, or Star; but it is ſo many Degrees and Minutes as is between the Sun or Star, and the Horizon; and therefore 'tis ſaid to be ſo far above the Horizon. I take Mr. *Norwoods* experiment for the beſt, who ſaith, That a Degree in the Heaven contains 69 *Engliſh* miles or thereabout; ſo that this is true, That if I take the Altitude of the Sun at any time, and find 53 Degrees from my Zenith, I ſay that there is 53 times 69 miles between the place where I am, and the place in whoſe Zenith the Sun was at that time: and by this means you may know how far it is to any place over which the Sun or Star is at any time.

Now in ſome Quadrants there is deſcribed a *Quadrat*, which is made of two lines comming from

from the Semidiameters A B and A C, as in the Figure you may ſee marked; and they are divided into 50 equal parts. That part of the Quadrat which is next the Sights, is called *The Scale of Contrary ſhadow*; and that other, *The Scale of Right ſhadow*. The uſe of the *Quadrant* is to take Heights and Diſtances without meaſuring them.

The beſt and moſt eaſie way for the taking Heights and Diſtances, is by the *Rule of Proportion*; becauſe then any ſtation taken will do the work; But becauſe ſome are not ſeen in Arithmetick, I will firſt ſhew how to take Heights and Diſtances without the *Rule of Proportion*.

Mark the place whoſe height you would know, and look through the Sights to the place, and go backwards or forward untill the thred fall juſt between the line of Right and Contrary ſhadow upon the Quadrat, which is upon 45. Degrees of the Quadrant; or elſe juſt upon one half of the parts of Right or Contrary ſhadow; or juſt upon one quarter of Right or Contrary ſhadow; then looking through the Sights towards the Center, obſerve till you find the thred fall juſt between Right and Contrary ſhadow; then is the height equal to the diſtance: but if it fall upon one half of the parts of Right ſhadow; then is the height but half the diſtance; if it fall

upon one quarter of Right ſhadow, then is the height but a quarter of the diſtance; if it falls on three quarters of Right ſhadow; then is the height three quarters of the diſtance.

Now of the parts of Contrary ſhadow; if the thred fall upon half the parts of Contrary ſhadow, then is the height double to the diſtance; if half way between this and the Semidiameter wherein the Sights are placed, then is the height four times as much as the diſtance. Now according as the Quadrat is divided you may find hereby the way to work the queſtion.

I will give you an example of theſe by which they may be the better underſtood.

I take a Quadrant that hath a Quadrat, the parts of whoſe right ſhadow are divided into fifty parts, and the contrary ſhadow into fifty parts and I would know the height of a Steeple: there looking through the Sights to the top of it, I find the thred to fall between Right and Contrary ſhadow; then I meaſure from the place where I ſtood, and find it to be 25. yards and an half between that and the foot of the Steeple, to which adding the height of my Eye from the ground, being a yard and an half, it makes 27. yards, the juſt height of the Steeple: for you muſt alwayes remember to adde the height of your Eye from the ground.

Again, looking to the top of the Steeple, the thred

thred falls upon 25. yards of Right ſhadow; and meaſuring, I find 51. yards between me and the foot of the Steeple; the half whereof is 25. yards and an half, to which adding one yard and an half for the height of my Eye makes 27. yards, the height of the Steeple.

Now taking another Station. I find when I look to the top of the Steeple, that the thred falls upon twelve parts and an half of Right ſhadow; and the diſtance I find to be 102. yards; one quarter of which is 25. yards and an half, and one yard and an half makes 27. yards, the height of the Steeple.

Now for the parts of Contrary ſhadow, looking to the top of the Steeple, I find 25. parts of Contrary ſhadow cut by the thred, and the diſtance between me and the foot of the Steeple, I find to be 12. yards and an half, which being doubled, make 25. yards and an half, and one yard and an half the height of my Eye makes 27. yards, the height of the Steeple.

Again, I look through the Sights to the top of the Steeple, and find twelve parts and an half of contrary ſhadow cut by the thred, and meaſuring from my foot to the foot of the Steeple I find it 6. yards and 13. inches, which doubling four times, it makes it 25. yards and an half; and one yard and an half added to it, is 26. yards, the height of the Steeple. Now

Now if ſtanding upon a known height you would know a diſtance, work as you did before; onely that which was then the parts of Right muſt now be the parts of Contrary ſhadow, and that which was then the parts of Contrary ſhadow, muſt now be the parts of Right ſhadow.

I will give you but two examples of this, and let the Reader ſtudy the reſt by this.

Standing upon a Steeple 27. yards high, let the Quadrant be lifted no higher then is the Steeple; if you do, you muſt allow ſo much as it is higher; I look to the root of a Tree, and find the thred to cut 25. parts of that which now is Contrary ſhadow; therefore doubling the height of the Steeple which is 27. yards, you have 54. yards, for the diſtance between the foot of the Steeple and the Root of the Tree.

Secondly, Looking to the bottom of an Houſe-wall, I find the thred fall upon 25. parts of that which is now right ſhadow; then is the diſtance between the foot of the Steeple and the bottom of that Wall but half the height of the Steeple, which half will come to be 13. yards and an half.

But if looking to a place the thred fall juſt between right and contrary ſhadow, then is the diſtance and height equal.

In the taking of diſtances upon a height, you muſt

muſt do contrary to what you did before; for there you looked firſt through the Sight furtheſt from the Center, but now you muſt look through the Sight next the Center firſt, and then through the next to the place you obſerve: and note, that by Heights we ſpeak onely of perpendicular or upright Heights, and in Diſtances onely of Levels.

Now follows the uſe of the Quadrant by Arithmetical Operations.

Firſt for the taking of heights: Take any ſtation and look to the top of the Wall, Houſe, Window, Steeple, or Tree, whoſe height you would know: but get your ſtation as near it as may be: then mark whether the thred fall upon the parts of Right or Contrary ſhadow; if it fall upon Right ſhadow, then, as all the parts of Right ſhadow are to the parts between the thred and the Semidiameter, ſo is the diſtance to the height.

But if the thred fall upon the parts of Contrary ſhadow, then, as the parts between the thred and the Semidiameter are to all the parts of Contrary ſhadow, ſo is the diſtance to the height; and of the contrary of theſe two it holds good: that is, That as in Right ſhadow as the whole of the parts is to the parts cut by the thred, ſo the diſtance is to the height; So on the contrary: As the parts between the thred

thred and the Semidiameter are to all the parts of Right ſhadow, ſo is the height to the diſtance, and in the parts of Contrary ſhadow it holds true,

That as all the parts of Contrary ſhadow are to the parts between the thred and the *Radius*, ſo is the height to the diſtance. So that obſerving this for a generall rule, it is eaſie to find any height or diſtance. I will give two or three examples in both theſe caſes: and firſt of Right ſhadow.

I take a Quadrant whoſe Quadrat hath each ſide divided in 50. parts, and looking to the top of a Steeple, I find the thred to fall upon 7. parts of Right ſhadow, and I meaſure to the foot of the Steeple, and find it to be 520. yards; then I ſay,

As 50. the whole of the parts of Right ſhadow is to 7. the parts between the thred and Semidiameter, ſo is 520. the diſtance given, to 72. Yards, 3 Foot, 4 Inches, the height required.

Example. I look to the top of a Tree through the Sights, and find the thred fall upon 44. parts of Right ſhadow, and from my foot to the foot of the Tree five yards; then I ſay,

As 50. the whole parts of the ſhadow is to 44. the parts cut by the thred; ſo is 5. yards the diſtance meaſured to 4. yards, 1 foot, and 2 inches, the height required. Now

Now for the taking of a diſtance, being upon a known height.

Example. Standing in a Window, ſo that between my Eye and the Ground are nine yards, and looking to the foot of a Tree or Houſe, I find the thred to fall upon 25. parts of Right ſhadow; then for the diſtance between the foot of the Tree and the foot of the Houſe, I ſay,

As 25. the parts whereon the thred falls, is to 50. all the parts of Right ſhadow; ſo is 9. yards the height given to 18. yards, the diſtance required. And alwayes when you ſtand upon a height to take a diſtance you muſt look through that Sight next the Center firſt.

Secondly, for the parts of Contrary ſhadow.

Looking to the top of a Houſe, I find the thred to fall upon 17 parts of contrary ſhadow, and the diſtance between me and the Houſe I find to be *6* yards: then I ſay by proportion.

As 17. the parts on which the thred falls, is to 50. all the parts of the ſhadow; ſo is *6*. yards, the diſtance to 17. yards 2. foot, the height ſought.

Example. Standing upon a Tower 50. yards high, I ſee a Hills foot through the Sights, and the thred falls upon 27. yards of Contrary ſhadow: therefore I ſay,

As 50. the whole content of the parts is to 27. the parts cut by the thred; ſo is 50. yards, the

the height, to 27 yards the distance of the place I saw. And so you may do in any case, observing well the general rule laid down before.

It resteth that I speak a little of knowing how to find a Height or a Distance, at two stations, measuring only the distance between them: for sometimes you cannot measure the distance to the Wall, by reason of some hindrance.

For the solution of this, do thus: Work as is before said: only whereas then you had either the height or distance given, now you must give a guess at the height or distance; and having supposed the distance to be so much; I have before shewed how to find the height: and also having the height supposed, to find the distance. This is laid down before, either when the thred falls upon the parts of Right or Contrary shadow.

Then having taken the height or distance by supposition, take another standing, and make your second observation; and taking the first supposed height for granted, find out your distance, as is taught before; having so done, you have these four things given; *viz.*

1. The supposed height.

2. The supposed distance from the first station to the thing you observe.

3. The distance from the second station; and by that,

4. The

4. The diſtance of the two ſtations one from another. All this is but ſuppoſed. Now meaſuring between the firſt and ſecond ſtations I find my errour; therefore all the errours being proportional, I ſay thus.

As the ſuppoſed diſtance between the two ſtations is to the true diſtance between them, ſo is the ſuppoſed height to the true height: and as the ſuppoſed diſtance is to the true diſtance of the ſtations, ſo is the ſuppoſed diſtance of either ſtation from the thing obſerved, to the true diſtance of either ſtation.

Thus you may take the height of a Mountain, or of a Houſe, Tree or any thing, and the true diſtance between you and the place juſt under the height you obſerve.

Now will I give examples of this, and ſo conclude with the Quadrat.

I would know the height of a Steeple, therefore taking one ſtation, I find the thred fall on 35 parts of Right ſhadow, and becauſe I cannot meaſure to the Steeple, becauſe of the unevenneſs of the ground, or ſome other impediment, therefore I ſuppoſe the diſtance 40 yards: Then I ſay,

As 50 the whole parts of the ſhadow to 35 parts cut by the thred, ſo is 40 yards ſuppoſed diſtance to 28 yards, the ſuppoſed height.

Then going a little further in a ſtraight Line,

Line, ſo that my firſt ſtation lie between my ſecond ſtation and the Steeple, I find the thred to fall upon 33 parts of right ſhadow: Then I ſay,

As 33 parts cut by the thred, is to 50 the whole parts of the ſhadow; ſo is 28 the ſuppoſed height, to 42 yards, 1 foot, 3 inches, the ſuppoſed diſtance of the ſecond ſtation: ſo that the ſecond ſtation is diſtant from the firſt ſtation by ſuppoſition 2 yards, 1 foot, 3 inches. Now if meaſuring theſe diſtances, I find it to be but 2 yards, 3 inches; Then I ſay,

As 2 yards, 1 foot, 3 inches the ſuppoſed diſtance of the ſecond ſtation is 2 yards, 3 inches their true diſtance ſo is 28 yards, the ſuppoſed height, to 24 yards, 4 inches the true height.

Then for the diſtance, I ſay,

As 28 yards the ſuppoſed height to 24 yards, 4 inches the true height; ſo is 42 yards 1 foot, 3 inches, the diſtance of the ſecond ſtation to 36 yards, 1 foot, 7 inches, the true diſtance of the ſecond ſtation.

Then for the diſtance of the firſt ſtation; Take away their difference 2 yards, 1 foot, 3 inches, and the remainder will be the diſtance of the firſt ſtation.

Thus ye may do when it falls upon the parts of Right ſhadow, but if the thred fall upon the parts

parts of Contrary ſhadow, then do as by this example following.

Looking through the Sights to the top of an hill, I find the thred to fall upon 20 parts of Contrary ſhadow; then ſuppoſe the height to be 84 yards, I ſay,

As 50 to all the parts of the ſhadow is to 20, the parts cut by the thred; ſo is 84 yards the ſuppoſed height to 33 yards two foot, the ſuppoſed diſtance of the firſt ſtation.

Then going further off, I make obſervation, and find the thred to fall upon 22 yards of Contrary ſhadow: Then for the diſtance I ſay,

As 50 the parts of Contrary ſhadow are to 22 parts, cut by the thred, ſo is 84 yards the ſuppoſed height to 34 yards, 2 foot 10 inches, the ſuppoſed diſtance of the ſecond ſtation: ſo that the difference by ſuppoſition between the two ſtations, is 1 yard and 10 inches.

Now if I meaſure the diſtance of the two ſtations, I find them to be diſtant three yards: I ſay firſt for finding the true height;

As 1 yard 10 inches the ſuppoſed difference of the two ſtations is to 3 yards their true difference; ſo is 84 yards the ſuppoſed height to 197 yards 7 inches the true height.

Therefore for the diſtance I ſay,

As 1 yard 10 inches the ſuppoſed diſtance of the ſtations is to 3 yards, their true diſtance; ſo is

3 yards, the ſuppoſed diſtance of the firſt ſtation to 77 yards, 1 foot, 5 inches, the true diſtance of the ſame firſt ſtation: To which if you add 3 yards, you have 80 yards, 1 foot 5 inches, the diſtance of the laſt ſtation.

And in the working of this, let the Reader be very exact. Firſt in his obſervations; Secondly, in his calculations; and then he need not doubt but his work will come true and right.

This might have been exceedingly illuſtrated, if prolixity had been affected; but I doubt not but by this a careful Student will accompliſh any queſtion either of the Heights or Diſtances of things; or in taking the Altitudes of the Sun, Moon, or Stars: And in thy reading, if any thing ſeem dubious unto thee, look forward or backward, and then thou wilt by comparing one thing with another, find out the real truth.

SECT. II.

Shewing the uſe of Hour-lines, and Azimuth-lines, &c.

BEcauſe the Quadrat and Quadrant fi not up the Inſtrument, but that there vacant places left without any inſcriptio

therefo

therefore many ingenious men have invented ſeveral Lines, &c. to fill them up with.

And firſt of all, *Stophler* (in his *Elucidatio Fabricæ uſuſque Aſtrolabij*) teaches to make Hour-lines for the time of the day; yet he deſcribes them in his Quadrant in ſuch an imperfect manner, that it is plainly to be ſeen he rather affected eaſe, then truth.

Since him, M. *Gunter* hath invented Hour-lines, after a more perfect way, and alſo illuſtrated the Quadrant with Azimuth-lines, and a Scale of the days of the Moneth, and Arches of the Horizon, and the Ecliptick line, and alſo the places of ſome notable Stars that lie between the Equator and Tropick.

Others have alſo exerciſed their wits in inventing ſeveral Conceits to fill the Inſtrument up with; as namely M. *De le Main*, M. *Outred*, M. *Foſter*, M. *Stirup*, M. *Dayry*, *&c.* All different one from the other, as I ſhall hereafter ſhew in convenient place.

But firſt I ſhall ſhew you the uſe of divers Lines that M. *Gunter* hath deſcribed in his Quadrant: and though they be ſufficiently and learnedly handled by himſelf in his Book; yet I think it not amiſs to make them plain and eaſie to be underſtood of ſuch as are not otherwiſe Mathematically given; but onely deſire to ſhow the uſe of the Quadrant, &c.

And therefore I ſhall begin with the Circle of Moneths, which you ſhall find deſcribed juſt within the Limb, in 4 Arches of Circles: one end of them reaching to 62 degres of the Quadrant, and the other to 15 Degrees of the Quadrant.

The two next the Quadrant or Limb, are from the tenth of *June* till the eleventh of *December*; all which time the dayes ſhorten to us who live under the North Hemiſphear: and in the ſame time the Sun goeth from the begining of ♋ to the begining ♎. The other two Circles do contain the other half of the year; that is from the eleventh of *December*, to the 10 of *June*; each Moneth at the beginning of it is noted with the firſt letter of that Moneth; as J F M A M J J A S O N D: That is *Jan. Feb. March*, &c.

Each of theſe Moneths is divided into every fifth day, or every particular day, as the largeneſs of the Inſtrument will bear it, by a ſmal ſtroke drawn croſs the two Circles; and thoſe ſtrokes that extend themſelves on the one ſide to the Limb, and on the other ſide to the Circle next above them, note the begining of a Moneth; and at that ſtroke is ſet the letter that notes the Moneth that begins.

Secondly, Next to this Circle of Moneths towards the Center, where the thred is faſtned, is a Circle (or rather an Arch of a Circle) drawn from one Semidiameter to the other; and the

is called the Tropick, and ſerveth in its uſe both for the Tropick of ♋ or ♑: at one end you may finde this Arithmetical Figure 8; and at the other end theſe two Characters of ♋ and ♑.

Thirdly, That Circle which you ſee part of is covered by the Quadrat, and hath theſe Figures upon it, 6. 7. 8. 9. 10. 11. 12. 30. 60. 90. is the Equator or Equinoctial: It is drawn from one Semediameter to the other, and is neareſt the Center of any other of the Circles.

Fourthly, That three-lined Circle which is drawn from the Figure 6 in the Equator to the end of the Tropick, and is divided into three times 30 diviſions is the Ecliptick; and upon it are put the Characters of the twelve Signs of the Zodiack, thus, ♈ ♎ ♒ ♓ ♉ ♍ ♌ ♏ ♊ ♐ ♋ ♑; but you muſt read them in due order, as ſhall be ſhewed hereafter.

Fifthly, From 6 in the Equator to the latter end of *February* in the Circle of Moneths, is drawn an Arch of a two lined Circle, and is divided into parts as the Ecliptick is; and is numbred from the Equator to the Tropick: This Circle is called the Horizon.

Sixthly, From the Equator to the Tropick upon the Semidiameter, is a diviſion of 23 equal parts, and one half of a part numbred 10 and 20: This is called the Line of Declination.

Seventhly, From 7. 8. 9. 10. 11. 12. in the

Equator, are drawn six Lines, bending towards the Line of Declination; and again, from 22 and 12 parts in the Line of Declination; and so from 6.7.8.9.10.11.12. in the Equator, and bending from the Line of Declination, and are nine in number: These crossing the other that bend towards the Line of Declination, are all of them called the Hour-lines. And here note, That the Hour-line which is drawn from 12 in the Equator, to the Tropick just over *June* in the Circle of Moneths, is the bounds of the Hour-lines. Between every two Hour-lines are drawn touches of lines thus - - - for the half Hour-lines and between every half and whole Hour-line is drawn prickt lines thus..... for the quarter Hour-lines.

Eightly, All those Circles drawn on the other side, of which I have said nothing yet, are the Azimuths, and are numbred by tens with 10, 20, 30, 40, 50, 60, 70, 80, 90. in the Equator; and with 100. 110. 120. upon the Semidiameter: and between every tenth Azimuth are drawn touches of lines thus ------ representing every fifth degree of Azimuth. The number of them drawn bending towards the Line of Declination, is 26; and those drawn bending the other way are 18 in number.

Ninthly, Ye may see *Peg. Wing.* or *Pegasus wing*, and *Arctus*, or *Arcturus*: and *Cor* ♌,

or

or the *Lions heart*: and the *Bulls eye*: and the *Vultures heart*: Each having placed by them a Star thus, * which are the names of five Stars which are all between the Equator in the Heavens and the Tropick of ♋: and to each Star is ſet down the day of the Moneth and Hour that it comes to the South.

Tenthly, The Sights which are two peeces of Braſs, with two little holes in them, to look through, or to let the Sun ſhine thorow; and theſe Sights are placed upon one of the Semidiameters.

Laſtly the Center, where the thred is faſtned, Beſides this it muſt have a Plumbet, and a Bead, upon the thred.

Note that this is the deſcription of a large Quadrant lately engraven and Printed by M. *Moxon*, and by him very accurately paſted on a Board, and fitted up with Sights and a Bead, *&c.*

The uſe of the Circle of Moneths, Ecliptick, Horizon, Line of Declination, Hour-Lines, Azimuths, and the five Stars, are briefly as followeth.

Firſt the Uſe of the Circle of Moneths.

TO find any day of the year required, firſt look out the Moneth; and then from the begining of it count at the firſt croſs ſtroke five dayes (unleſs the Moneths be divi-

ded into particular dayes,) and the next ſtroke five more, that is ten dayes; till you come at the day you look for.

Example. I would find the 17. day of *November*; then having found *N* for *November*, I count towards *December*, that is, towards *D*, and ſay, 5, 10, 15, 20. therefore between 15. and 20. muſt be 17. ſo I gueſs at the 17. day, and lay the thred upon it, & find it to fall upon 17 Degrees and an half in the Limb. Now in *June* or *December* 'tis hard to find the day of the Moneth, or to 7. or 8. dayes, but all the reſt of the year it is eaſie enough.

2. Having found the day of the Moneth, to find how high the Sun will be at Noon.

Lay the thred upon the day of the Moneth, and the Degree cut by the thred in the Limb, is the Meridian Altitude, or the height of the Sun at Noon; ſo the height of the Sun upon the 18. day of *May*, you will find to be 41 Degrees 45 Minutes.

3. To find what dayes of the year are of equal length.

Lay the thred upon the day given, and on the other ſide it will fall upon the day equal in length to that.

Example. I deſire to know what day is juſt as long (or as ſhort) as the 18. day of *March*; I lay the thred to the 18. of *March*, and on the other

other ſide it falls upon the 5. day of *September*; ſo that theſe two dayes are both of a length, and the height of the Sun at Noon upon either of them is 41 Degrees 45 Minutes.

Note that the height of the Sun at Noon here given is true onely at the renowned City of *London*, or at any place that lieth due Eaſt or Weſt from it; but in any place that is 70. Mile more North then Eaſt or Weſt of *London* to them, the Sun will be a degree lower then by the Quadrant (fitted for *London*) will appear; but if you be 70. Miles South of *London*, then will the Sun be a Degree higher then the Quadrant will ſhew; and ſo allowing 70. Miles for a Degree, you may make this Quadrant univerſal in this thing.

4. If you have the height of the Sun at Noon, you may find the day of the Moneth; but this is difficult to do it truly.

Secondly, *The Uſe of the Ecliptick Circle.*

THis Circle as is before-ſaid, is drawn from ſix in the Equator, to the other ſide of the Tropick, and is divided into each ſingle Degree; and at the begining of each Sign is a long ſtroke; and at every tenth Degree a ſtroke a little ſhorter, and each fifth Degree with a ſhorter ſtroke. Now upon this Arch are the Characters of the 12 Signs, which you muſt note follow one another in this order,

♈ ♉ ♊ ♋ ♌ ♍ ♎ ♏ ♐ ♑ ♒ ♓ : and theſe twelve Signs anſwer to the twelve Moneths of the year, and do proceed on in order.

And here is to be noted, that the Sun enters ♈ upon the tenth of *March*, and ♉ the tenth of *April*, and ſo of the reſt; ſo that in *February* the Sun will be found to be in ♓. Now I ſhall ſhew you how to ſet your Bead for any day, which muſt be done thus:

From twelve in the Equator to the end of the Circle of Months, is drawn an Hour-line; and from the ſame twelve in the Equator, to the other end of the Circle of Moneths, is drawn another Hour-line.

That which falls upon *December*, is the Hour-line of twelve in the Winter; and the other the Hour-line of twelve a Clock in the Summer: Now lay the thred upon the day of the Moneth, and move the Bead up or down, till it be juſt upon one of theſe two Lines, and ſo is your Bead rectified for that day. So upon the 18. of *March*, bring the thred to the day of the Moneth, and move the Bead up or down, till it fall upon the Hour-line of twelve in the Summer.

How to find theſe three things following upon the 18. *of March.*

1. *To find the Suns place in the Ecliptick.*

Having rectified the Bead, as before, bring it

it to the Ecliptick, and it will fall upon the Degree the Sun is in that day: ſo upon the 18. of *March* I find the Sun to be in 8 Degrees of ♈; and upon the 17. of *October*, I find it to be 3 Degrees of ♏, ♏ being the Sign anſwering to *October*. And ſo by the contrary: If you know the place of the Sun you may find the day of the Moneth.

2. *To find the Suns Declination.*

Having rectified the Bead as before, bring it to the Line of Declination, and it will ſhew you the Declination of the Sun for that day: Thus upon the 17. of *October* I find the Sun to have 12 Degrees Declination; and upon the 18. of *March*, it hath three Degrees and an half Declination: And note, that if the Bead fall upon the Winter twelve a clock Line, then is the Declination South; but if the Bead fall upon the Summer-Line of twelve a clock, then the Declination is North: and by the ſame way if you have the Suns Declination given, you may find his place in the Ecliptick, and the day of the Moneth.

3. *To find the Right Aſcenſion of the Sun.*

Having rectified the Bead, bring it to the Ecliptick, and the Degrees cut by the thred in the Limb, is the Right Aſcenſion: But when the Sun hath gone three Signs from ♈, for every three Signs you muſt add 90 Degrees to the

the Right Aſcenſion cut in the Limb; and then have you the Right Aſcenſion. Thus upon the 18. of *March* the Right Aſcenſion is 12. Degrees; and upon the 5. of *Auguſt* 126 Degrees (and upon the 10. of *October* it is 208 Deg. and upon the 9. of *March* it is 360 deg.

Thirdly, *The uſe of the Horizon Line.*

THis double-line is divided in 40 parts; and numbred with 10, 20, 30, 40. The uſes of it are three, *viz.*

1. *To find the Suns Amplitude, or his Riſing or Setting from the true Eaſt or Weſt point of the Compaſs, in the Horizon of* London.

Having rectified the Bead, bring it to the Horizon, and it will ſhew the Amplitude. Thus upon the 9. day of *April* the Amplitude is 19 Degrees toward the North: And note that from the 10. of *March*, to the 11. of *September*, it hath North Amplitude; but all the reſt of the year, the Amplitude is South.

2. *To find the Aſcenſional difference.*

Rectifie the Bead, and bring it to the Horizon, and the Degrees cut in the Limb ſhall be the Aſcenſional difference: Thus the Aſcenſional difference the 9. of *April* is 15 Degrees; and having the Aſcenſional difference, 'tis eaſie to find the time of Sun-riſing and Setting; and thereby the length of the Day and Night.

For

For the time of Sun-riſing.

Find out the Aſcenſional difference, then if the time be between the 10. of *March*, and 11. of *September*, allow for each Degree of Aſcenſional difference 4. Minutes of Time: for ſo much doth the Sun riſe before 6. in the Summer, and after 6. in the Winter.

So upon the 9. of *April* I have 15. Degrees of Aſcenſional difference, which is 15. times 4 Minutes, that is juſt an hour: Now becauſe 'tis in the Summer, I ſay the Sun riſeth an hour before 6. in the morning, that is, at 5. a Clock in the morning. And note that ſo much as the Sun riſes before 6. ſo much it ſets after 6. and ſo much as it riſes after 6. ſo much it ſets before 6.

To find the length of the day is eaſie; for counting the time from Sun-riſing till Noon the ſame day, I have 7 hours; and the Afternoon being alwayes the ſame length as the Forenoon is of, gives me 7 more; which added together, makes 14 hours for the length of the day; which taken from 24 hours, leaves 10 hours the length of the Night. Thus ye may find the time of Sun-riſing and ſetting, and the length of the Day and Night, to a Minute of Time.

Fourthly, *The uſe of the Hour-lines.*

THoſe Lines that are drawn from 6, 7, 8, 9, 10, 11, 12, in the Equator, bending towards

wards the Line of Declination, are the hours of the day in the Winter, and of the night in the Summer; and they are numbred first in the Equator, to shew what hour they do belong to: And again they are numbred above the Tropick. The other Hour-lines drawn bending from the Equator, are the hours of the day in the Summer, and of the night in the Winter; they are numbred in the Equator, and in the Tropick; so that the first drawn from 12. in the Equator to the end of *June*, is 12. a Clock at Noon in Summer, and 12. at Night in Winter; the next is 11. or 1. a clock before Noon in Summer, and 11 and 1 a clock at night in Winter; and so you may find out all the rest, as by the ensuing particulars will more plainly appear.

Having the height of the Sun, to find the Hour of the Day.

First rectifie your Bead, then take the Altitude, and the Bead will fall upon the hour of the Day: As for example.

I rectifie the Bead upon the 9. of *April*, and taking the height of the Sun, I find it 31 Degrees high, and the Bead at that observation fell just half way between the Lines of eight and nine in the Equator, and three and four at the Tropick; so that it is half an hour past 8. in the Morning, or half an hour past 3. in the Afternoon: now if the Sun rises higher, it is before

Noon

Noon; but if it deſcend lower and lower, then 'tis Afternoon.

And ſo by the ſame way upon the firſt of *November* I make obſervation, and the Bead falls half way between 1. and 9. and 3. and 4. in the Winter Circles; therefore 'tis half an hour paſt 3. in the Afternoon, or half an hour paſt 8. before Noon: and thus with a little diligence you may find the hour of the day to a ſmall matter.

To know how high the Sun will be at any Hour.

Rectifie the Bead, then bring it to the time given, and the thred will cut ſo many Degrees in the Limb, as the Sun will be high at that time: thus upon the 30. of *March* I find that at 8. a clock in the Morning the Sun is 24 Degrees and an half high, and it comes to the ſame height at 4. in the Afternoon the ſame day.

To find how low beneath the Horizon the Sun is at any Hour of the Night.

Rectifie the Bead for the preceding day, and bring it to the hour of the Night, and in the Limb the thred will ſhew you how low the Sun is at any time of the Night: thus upon the 30. of *March* at 11. at Night the Sun is 28 $\frac{2}{1}$ degrees low beneath our Horizon.

To find the time of Day-break.

This is when the Sun is 18 Degrees beneath

neath our Horizon; Therefore rectifie the bead for the day, and lay the thred upon 18 Degrees in the Limb, and the bead will fall upon the hour of day-break; so upon the 30 of *March* the day will break at three of the clock in the Morning. And by this is easie to find when it will be dark at Night, for that must be so much after 6, as this is before 6, which is 3 hours; so at 9 at Night it will be dark, or past Twilight.

As on the left hand of the Quadrant, the Hour-lines are drawn bending from the Equinoctial to the Tropick; so likewise on the right hand of the Quadrant are drawn such other Lines, which bend also from the Equinoctial to the Tropick, and are called Azimuths; and are numbred in the Equinoctial with 10, 20, 30, &c. to 90. and then downwards from the Equinoctial to the Tropick with 110, 120, 130. and some odd degrees of Azimuth. Now on the Quadrant I mentioned before, you have not onely every tenth Azimuth-line described, but also every fifth Azimuth-line drawn with such touches of Lines as the half hours are marked with.

Fifthly, *The use of the Azimuth-lines.*

Note. THat those Lines that bend towards the Line of Declination, are the Summer Azimuths: and that which is neareſt the Line of Declination, which is on the left hand, is the Meridian Line, or full South in Summer.

And

And all thoſe drawn the other way are the Winter Azimuths; and that next the Line of Declination (though bending from it towards the right hand) repreſenteth the Meridian, or full South point of the Compaſs in the Winter. But

To find the point of the Compaſs wherein the Sun bears at any height, do thus:

Firſt rectifie your Bead: then take the Altitude of the Sun, and obſerve well that Altitude, and ſo much as your Altitude is, count ſo many Degrees in the Limb from 90. and bring the thred to that Degree; then will the Bead fall upon the true Azimuth.

Example. Upon the 9. of *April* I take the height of the Sun, and find it to be 25 Degrees; therefore I lay the thred 25 Degrees from 90 Degrees, and the Bead falls upon almoſt 80 Degrees from the Meridian; whether this 80 Degrees be from the Meridian to the Eaſtward, or to the Weſtward, I know by the time of the day; for if it be after Noon, then it is 80 Degrees to the Weſtward; but if before Noon, 80 Degrees to the Eaſtwards: this is of many great uſes, and therefore I will ſhew how to draw a Compaſs upon any place whereon the Sun ſhines, be it either upon a Wall, or on the Ground.

Firſt, with a pair of Compaſſes deſcribe a

good large Circle, the bigger the better; then when the Sun ſhines upon the Circle, ſet a ſmall ſtick or nail upright in the middle or Center of the Circle; then take the height of the Sun, and note it well; then preſently make a mark at the end of the ſhadow of the nail or ſtick; then take away the nail, and lay a Ruler over the Center, and the mark you made at the end of the ſhadow, and ſo draw a Line from one ſide of the Circle to the other, by the ſide of the Ruler, then (as is before ſhewed) you may find how much one end of that Line is from the true South: then having ſo many Degrees as the Sun was from the South, lay the Center of the Quadrant upon the Center of the Circle; and from the Center of the Quadrant extend the thred to the place of the Sun upon that Circle, and bring that Degree which you know the Sun is from the Meridian under the thred, and one end of the Limb will point at the true South, the other at the Eaſt, if it be before Noon; but to the Weſt, if it be after Noon; then is the North oppoſite to the South, and ſo have you the true Eaſt and Weſt, North and South of any place whatſoever, which is any thing near *London*; as within 100. miles the error will be but ſmall, but if it be true Eaſt or Weſt from *London*, the error will be ſcarce any thing.

And

And thus you may find ſeverall particulars; as in finding how one place lieth from another: and alſo to deſcribe a Dyal on a plain level place: and how much the Magnetick Needle varies in any place.

Now you may divide the Circle you make into 360 Degrees, and deſcribe the 32. points of the Compaſs, and many very rare concluſions. And as I deſire thee to take heed of all errors and miſtakes, ſo eſpecially in this, that you be ſure to account your Altitude from 9. towards 10. degrees in the Limb; for this you muſt alwayes do in finding out the Suns Azimuth, or point of the Compaſs; and ſo by the contrary 'tis eaſie.

To find the height of the Sun at any Azimuth; thus:

Rectifie the Bead, then bring it to the Azimuth whereon the Sun is: and ſo many Degrees in the Limb, as is between the thred and 90 Degrees, or the end of the Limb; ſo much is the Altitude at that time.

Laſtly, *The uſe of the five Stars is thus.*

PUt the Bead to the Star you intend to obſerve, and find how many hours it is diſtant from the Meridian, or 12. at Night, as you found how far the Sun was diſtant from 12. at Noon; then find the Right Aſcenſion of the Sun, and alſo the Right Aſcenſion of that

Star; then out of the one take the other, and turn the reſt into Time, allowing 15 Degrees for an hour, and 4 Minutes for a Degree; then that time you found to remain after the ſubſtraction, add to the hours you find the Star from the Meridian, and they will make the time that it is ſince twelve a clock at Noon.

The Uſe of the
NOCTURNAL.

1. *What the Nocturnal is.*

IT is an Inſtrument conſiſting of two parts.

1. A *Circle*, which is divided into 24 Hours; and each Hour into ſo many parts as the ſpace between each Hour will admit of.

The Nocturnal fitted to the back ſide of that Quadrant I have already treated of is divided into four quarters, and each quarter into two parts; ſo as the whole hour is divided into eight equall parts, each equal part containing ſeven Minutes and an half, as you may ſee in the Nocturnal it ſelf; upon the hour of 12 there is placed a *Flower de Luce*, to ſignifie the North point; and in the outmoſt Circle the names of all the other points of the Mariner's Compaſs.

Th

The ſecond part of it is a *moveable Rundle*, the Circle whereof is fixed to the Center of the Circle of Hours, that ſo you may turn it round as occaſion requires. The outmoſt Circle of this Rundle is divided into 12 parts, for the 12 Moneths, each Moneth having its name prefixed to it in Roman Capital Letters, and each day in the Moneth diſtinguiſhed with a ſmall ſtroak, and every tenth ſtroak for the readier counting the dayes drawn longer, and marked with figures thus 10, 20, &c. according to the number of ſtroaks from the beginning of the Moneth.

Within the Circle of Moneths is another Circle deſcribed, divided into 12 equal parts, repreſenting the 12 Celeſtial Signs, every Sign having its name prefixed to it in Italian Capital Letters; and each Sign ſub-divided into 30 Degrees, and each tenth Degree marked 10, 20, or 30, according to the number of Degrees from the begining of the Sign.

In the reſt of the Plane within this Circle is deſcribed thoſe fixed Stars that are near the North Pole, and belonging to ſeven Conſtellations; whereof that which is in the middle, is called URSA MINOR, of ſome HELICE MINOR) which in Engliſh is the *little Bear*, it being in the form a Bear.

This Conſtellation conſiſts of ſeven Stars,

whereof three onely are ſplendent; that is, the *Pole-Star* in the end of the *Tayl*, and thoſe two that are in the fore-parts of the *Bear*, one of them upon his Back near the Neck, and the other upon his ſide; and theſe two are called of our Mariners *the Guards*. Theſe three Stars are of excellent uſe in Navigation, and well known by Sea-men.

The next Conſtellation is DRACO, or the *Dragon*, and hath ſundry Stars, which you may learn to know by the Rules following. The third is CEPHEUS. The fourth is CASSIOPEIA. The fifth is URSA MAJOR, or the *great Bear*. The ſixth AURIGA. The ſeventh CYGNUS.

And laſtly, there is twelve Lines drawn from the Pole, which are Meridians, and are of great uſe: as you ſhall learn hereafter.

Here followeth ſeveral Uſes of the Circles of the Nocturnal.

1. The Circle whereon the Rundle is fixed, which is divided into 24. hours, notes the 24. hours of the Night and Day, and alſo the quarters of every hour, and half of each quarter, which is but ſeven Minutes and an half; ſo that you may work to half a quarter of an Hour of Time by this Inſtrument; be it either Time given, or Time ſought for, as the queſtion importeth.

2. The

2. The uſe of the Moneths, and their diviſions into dayes, is either to give the day of the Moneth ſought for, or by the day of the Moneth given, to find another thing required, as the queſtion imports.

3. The uſe of the Circle of Signs is to know the Place of the Sun in the Ecliptick every day in the year.

4. The uſe of the Stars and their Conſtellations is two-fold: 1. To learn to know thoſe Stars one from another, and from all other Stars. And 2. Knowing them, to make uſe of them, as the queſtion ye are to reſolve requires.

And note this, That that Star which is in the *Tayl* of the *little Bear*, is neareſt the North Pole, and as in the Rundle all the reſt of the Stars ſeem to move round this Star, ſo do they in the Heavens ſeem to move round it alſo: This being an exact Type or Figure of the Stars near the Pole.

5. The uſe of the Meridian lines which meet in the Pole is threefold: 1. For the more eccular diſtinction of each Sign. 2. To ſhew the Right Aſcenſion of any Star deſcribed in the Rundle. 3. For the finding the Declination of any Star on the Rundle, one of the Meridian Lines, *viz.* that which paſſes through the beginning of *ARIES*, is divided into de-

grees of Declination. And 4. To ſhew how to bring any Star to the Meridian of the Nocturnal, which is the hour of 12 under the *Flower de Luce.*

And becauſe we ſeldome ſee a Star juſt upon the Meridian, therefore do theſe Meridians alſo ſhew how to place the Star either ſhort or paſt the Meridian, which we could not elſe do well by gueſs.

Thus much I judged meet, not only for the uſe that theſe definitions are of in the uſe of this Inſtrument, but becauſe they may ſatisfie the deſire of ſome that are not verſed in Mathematical Phraſes, and yet would willingly know the reaſon of ſuch things. I ſhall now ſhew you a few of the moſt practical uſes of this Inſtrument, that may be eaſily underſtood of thoſe that are not Mathematically diſciplined.

First then, *To learn to know the Stars deſcribed in the Rundle one from another, and from the reſt of the Stars that we ſee in the Heavens.*

In a Night when the Stars may be ſeen, look toward the North part of Heaven, and there you may take notice of ſeven very bright Stars, lying in the ſame form as we ſee in the Image of the *great Bear*; four lying in a ſquare, or like the four Wheels of a Wagon, and three, which you may imagine to be three Horſes following one

one another; the form how they lie, you may ſee in the Rundle between the Signs *Virgo* and *Libra*: theſe being well known, you may look what Star lies near any one of them, and there you will find what Star it is. As for *Example*:

I ſee a Star lying juſt over the Star in the great Bears back: looking in the Rundle I find that Star to be in the end of the *Dragons tayl*, and ſo you may learn to know them all one from the other, comparing the Stars ye ſee in the Heaven, to them that are in the Rundle; and though you may ſee many Stars in the Heaven, yet theſe are the brighteſt, and of greateſt Magnitude amongſt them.

Another way to know the name of a Star, and to know it from others.

Firſt note a Star in the Heaven, that you ſee is upon, or near the Meridian; then look in the Nocturnal for the day of the Month, and bring that day to the Hour of the Night next the *Flower de Luce*, then look what Star lieth between the *Flower de Luce* and the Pole in the Rundle; and if the Star in Heaven be lower then the Pole, the Star you find in the Nocturnal ſhall be the Star you ſaw in Heaven: But if the Star you ſaw in Heaven be above the Pole, then muſt you ſeek the Star between the Center and the South point of the Nocturnal. But then if looking on the Rundle you find two

Stars

Stars on the Meridian, note which is neareſt the Pole, and which furtheſt off, and ſo you may know each from other.

Example. Upon the firſt of *April*, at half an hour paſt nine at Night I ſee two bright Stars upon the Meridian, the one nearer me then the other: then to know the names of thoſe two Stars, and to know them from others, I bring the firſt of *April* to half an hour paſt nine nere the *Flower de Luce*; (which *Flower de Luce* notes Mid-night;) and becauſe the Stars in Heaven are higher then the Pole, I look from the South point of the Nocturnals Limb towards the Center of the Nocturnal, and then ſee the Star neareſt me (as it lies in Heaven) to be in the *Belly* of the *great Bear*; and that furtheſt from me, to be in the back of the *Bear*; and then looking a little to the Eaſtwards in Heaven, I ſee two more follow, and after them cometh three more: for theſe I look in the Rundle, and one of the two next to the two I found on the Meridian, is upon the *great Bears Thigh*; the other upon his *Buttock*: The firſt of the three following is in the root of the *Tayl*, the ſecond about the middle of the *Tayl*, the third in the end of the *Tayl*: And by this you may come to know all the Stars inſcribed in this Rundle.

How

How to finde out the North Star, from the reſt which you ſee in Heaven.

This ſtar is very bright, being one of the ſecond Magnitude or bigneſs.

The moſt exact and ſpeedy way is this:

Take your Quadrant, and as near as you can gueſs, look through the Sights of your Inſtrumen: into the North part of the Heaven ſo high as is the Latitude of your place, and it will ſoon ſhew you whereabout it is, for there is no ſtar ſo great near it; & when you have thus found it, be ſure you note it well how it lies frō other Stars, that you may know it again: thus at *London* the latitude being 51 Deg. & an half, I lift up the ſights of the Quadrant till the thred fall upon 51 Degres and an half; then looking ſtill at that height, I look as near the North point as I can gueſs, and there, or very near, is the Pole or North-ſtar: if you have a Magnetique Needle that will ſhew you the North point of Heaven.

The next way to find the North ſtar is this which is done without any Inſtrument.

Look into the North part of Heaven; Note ſome Star that is little above half the height of Heaven, from the lower part of the Heaven; and by diligent notice ſee whether in an hours time or more, you can ſee it remove from the place where you firſt ſaw it; if it be removed, that is not the Star; and ſo continuing, note the Star that

that lyeth as before-ſaid, half above the Horizon, and moves not, and that is the Pole-Star; and this Star will be the ſooner known becauſe it is more remote from any bright Star then any Star near it.

The reaſon why this Star ſcarce moves, is becauſe it is near the Pole, and the other Stars moves round this: yet is not this Star without a motion, for it moves round the true Pole, but the Eye can ſcarce perceive it to move at all.

An example of this in a Night when the Stars may be ſeen:

I look up half way into the Heaven, and a little higher, and as near North as I can; which I know by the building of a Church, whoſe Steeple ſtands alwayes Weſt from the Church, and there I ſee a bright Star by it ſelf, and it ſtands ſo that I may juſt ſee it by the edge of a Houſe-wall; then I mark how and where I ſtood, and go away, and come two, three, four, or five hours after, and ſtand juſt in the place as I did before, and find that the Star is not removed out of that place; therefore by all tokens this muſt needs be the Pole-ſtar: but if I find the Star removed, I conclude that that is not the Star, but I try another, and another, till I find it; taking this for a ſure ground, that it lieth full North from me, and that a little above half of the height of the Heaven, or thereabout, in the Latitude of 51 Degrees. The

The next thing is, how to know the Meridian in the Heavens.

Having found out the North-Star, fix your Eye upon it, and imagine as near as you can a direct Line to be drawn from that Star to the place in the Heaven right over your Head, and that Line is the Meridian; and when you ſee any known Star come to this Line, then is that Star upon the Meridian; when a Star is not quite come to it, that Star is ſaid to want of its comming to the Meridian; when a Star is gone paſt this Line, 'tis paſt the Meridian; and this Line (for ſo I call it, becauſe all men know not the meaning of an Arch) is an Arch of the true Meridian of the place; and whereas I ſay let this Line be drawn from the Pole-Star, it is for the eaſe of thoſe who are not verſed in Aſtronomy; though the true Arch of the Meridian muſt be drawn from the true Pole, yet in the uſe of this Inſtrument it begets no ſenſible error to draw this Line or Arch from the Pole-Star.

To find the Right Aſcenſion of any Star in the Rundle.

Count according to the ſucceſſion of Signs the number of degrees comprehended between the begining of *ARIES*, and a Line drawn through the Center and your Star to the Circle of Signs, for that is the number of degrees of Right Aſcenſion your Star hath. *Ex.*

Example, I desire to know the right Ascension of the bright star in the end of the *great Bears Tayl*. I lay a thred from the Pole through that Star, and draw it to the Circle of Signes: then begining to number at *ARIES* & proceeding to *TAURUS*, *GEMINI*, &c. I say, 30, 30, 30, is 90. 30, 30. 30. is 90. more, that is 180, which is the begining of *LIBRA*, and almost 24 more, which is contained between the begining of *LIBRA* and the thred, that is almost 204 degrees for the right Ascension of the Star in the end of the *great Bears Tail*.

To find the Declination of any Star on the Nocturnal.

Pitch one foot of a pair of Compasses in the Center of the Nocturnal and extend the other foot to the Star: then keeping the first foot in the Center, turn the other foot to the divided Meridian line, and so many degrees as is contained between the two feet of the compasses is the Complement of the Stars Declination: that is so many degrees the Star wants of 90. Thus the Declination of the aforesaid Star in the end of the *great Bears Tayl* is found to be 51 degrees and one quarter of a degree.

The day of the Moneth, and a Star on the Meredian being given, to find the Hour of the Night.

Bring the Star which you see upon the Meri-

dian

dian to the *Flower de Luce*, and then look for he day of the Moneth; and right againſt it you ave the hour of the Night given.

Example. Upon the firſt of *April* at Night, I ee the bright Star in the rump of the *great Bears Tayl* upon the Meridian, therefore I bring t to the *Flower de Luce*, and looking upon the irſt day of *April* I find it is ¼ of an hour paſt 1.

Next, *The Hour of the Night, with a Star pon the Meridian given, to find the day of the Moneth.*

Bring the Star to the *Flower de Luce*, and ight againſt the hour of the Night, is the day f the Moneth. This needs no Example.

The day of the Moneth, with the Hour given, o know what Star is upon the Meridian.

Bring the Time of the Day, and the Day of he Moneth together, and what Stars you find pon a right line imagined to paſs between the lorth and South points of the Nocturnal, thoſe re upon the Meridian.

The Day of the Moneth given, to find the Sign and Degree the Sun is in.

Seek the Day of the Moneth in the Rundle of he Nocturnal, and againſt it in the Circle of ignes you will finde the Signe and Degree the un is in.

FINIS.

GLobes of all sizes Celestiall and Terrestrial, Spheares Ptolomaick, and Copernican, The Mathematical Jewel, and several other Instruments of the like nature, are made and sold by Joseph Moxon *at his shop on* Ludgate-hill *near* Fleet Bridge, *where you may have Books for the use of all these and severall other Instruments. Also Mapps for all Countreys, and Sea-Platts for all Navigations.*

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